OHIO RIVER BASIN PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 40, NWS HYDRO-35* and *Technical Paper No. 49*

Twenty-first Progress Report
1 October 2004 through 31 December 2004

Office of Hydrologic Development
U.S. National Weather Service
National Oceanic and Atmospheric Administration
Silver Spring, Maryland

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DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various technical tasks associated with this project. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any purpose other than for what it was intended does so at their own risk.

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1. Introduction

The Hydrometeorological Design Studies Center (HDSC), Hydrology Laboratory, Office of Hydrologic Development, U.S. National Weather Service has updated its precipitation frequency estimates for the Ohio River Basin and surrounding states. Previous precipitation frequency estimates for this area were contained in *Technical Paper No. 40* "Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years" (Hershfield, 1961), *NWS HYDRO-35* "Five- to 60-minute precipitation frequency for the eastern and central United States" (Frederick et al., 1977) and *Technical Paper No. 49* "Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States" (Miller et al., 1964). The new project included collecting data and performing quality control, compiling and formatting datasets for analyses, selecting applicable frequency distributions and fitting techniques, analyzing data, mapping and preparing reports and other documentation.

The project determined annual all-season precipitation frequencies for durations from 5 minutes to 60 days, for average recurrence intervals from 2 to 1,000 years. The project reviewed and processed all appropriate rainfall data for the project area and used accepted statistical methods. The project results are published as Volume 2 of NOAA Atlas 14 on the internet (http://www.nws.noaa.gov/ohd/hdsc) with the additional ability to download digital files.

The project produced estimates for 13 states. Parts of nine additional bordering states were included in the original analysis to ensure continuity across state borders. The core and border areas and regional groups used for long duration (24-hour through 60-day) analyses are shown in Figure 1. Regional groups used for short duration (60-minute through 12-hour) analyses are shown in Figure 2.

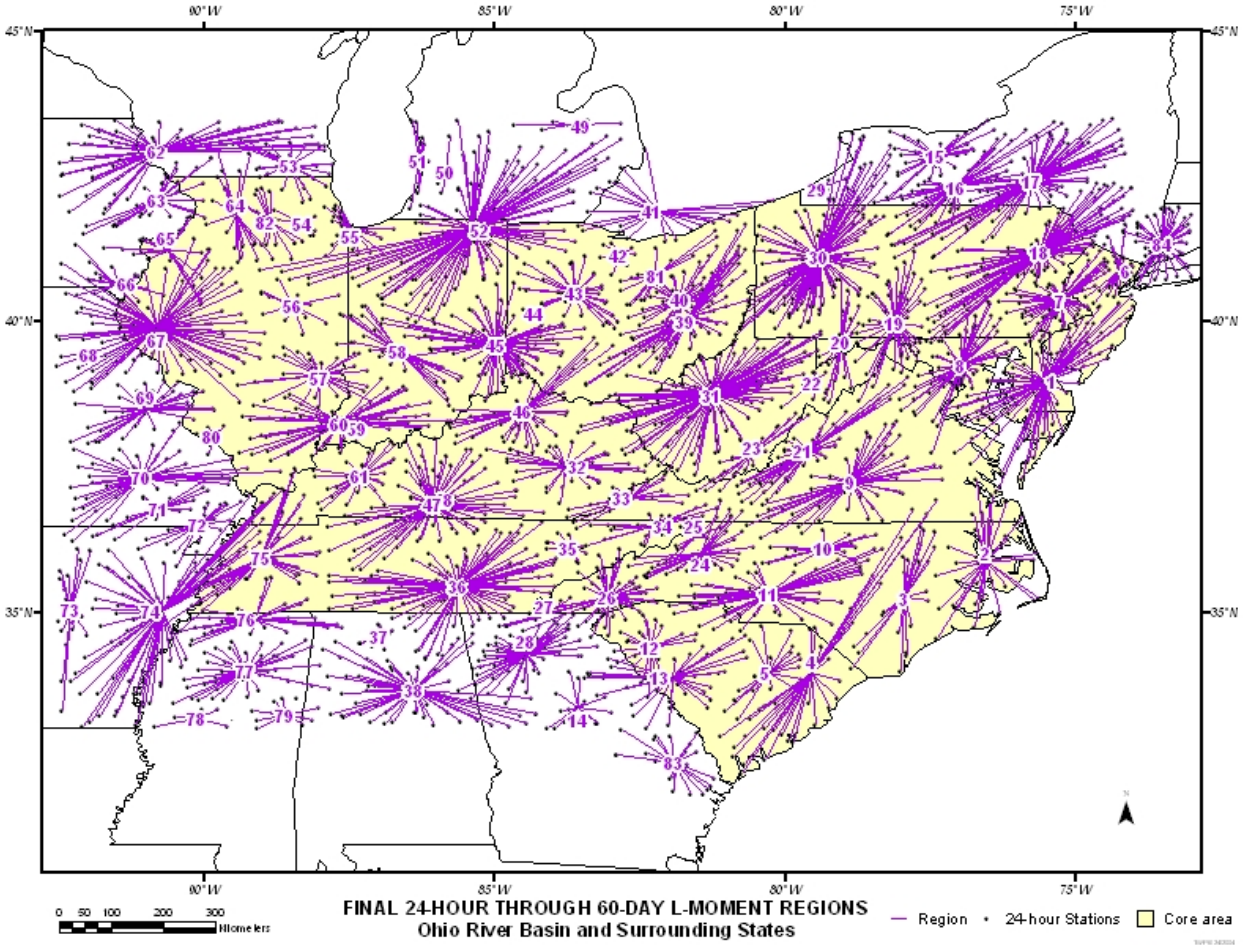


Figure 1. Ohio River Basin project area and 84 daily regional groups.

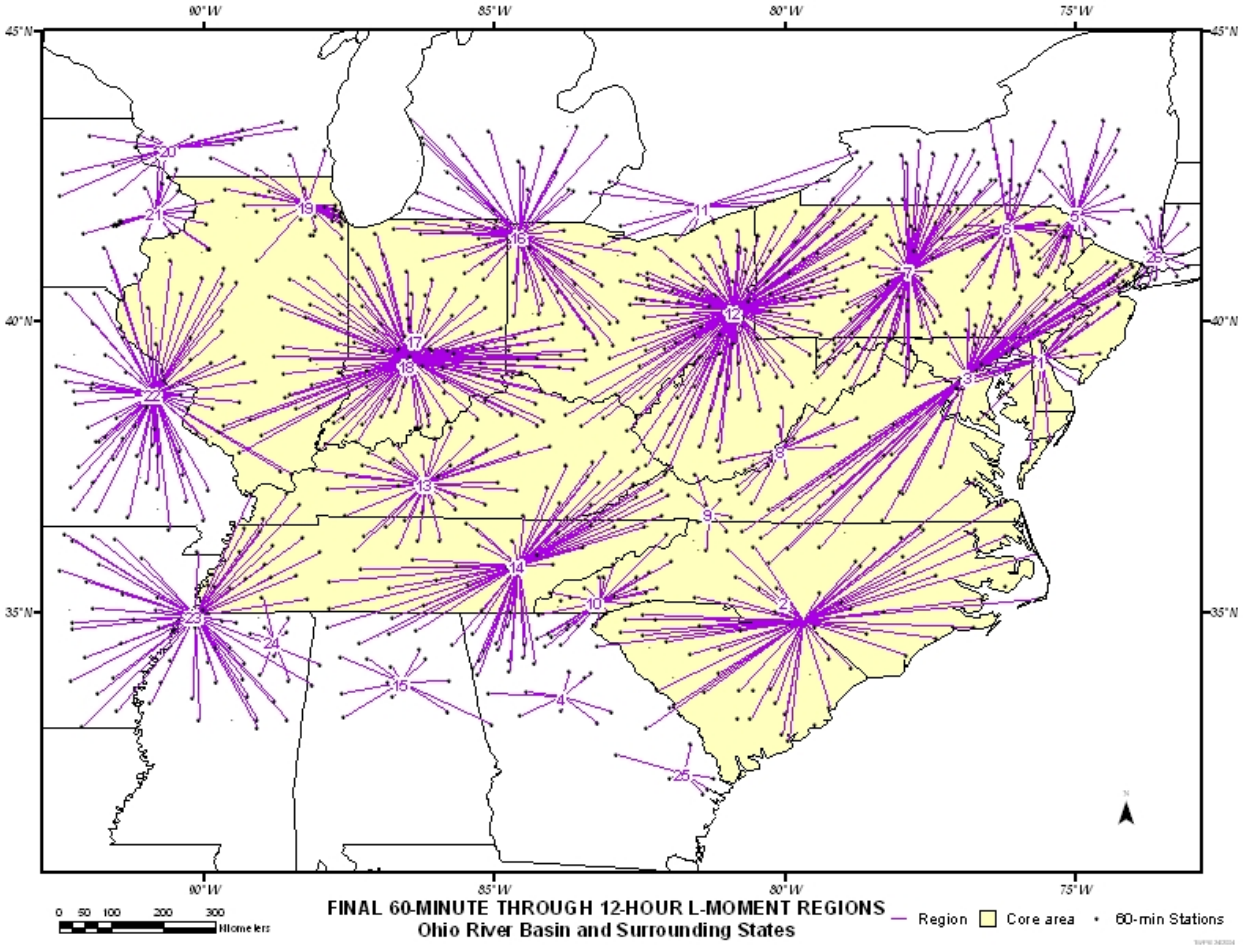


Figure 2. Ohio River Basin project area and 26 hourly regional groups.

2. Highlights

Cartographic maps for all durations and all average recurrence intervals for NOAA Atlas 14 Volume 2 are available on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html. Significant progress has been made on the final documentation, NOAA Atlas 14 Volume 2, to accompany the precipitation frequency results. Additional information is provided in Section 3.1, Final Documentation.

The Precipitation Frequency Data Server (PFDS) - the on-line portal for all NOAA Atlas 14 deliverables and information - underwent several subtle, but important changes. The computer server for the PFDS was replaced with a much faster computer which reduces waiting time when downloading results. Additional information is provided in Section 3.2, PFDS.

Progress continues in the development of geographically-fixed Areal Reduction Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing of software is 95% complete. There are currently 14 study areas located throughout the conterminous U.S., Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis. Additional information is provided in Section 3.3, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Final Documentation

The complete set of NOAA Atlas 14 Volume 2 (Ohio River basin and surrounding states) color cartographic-quality maps were posted to the PFDS. The cartographic maps for all durations (5-minute through 60-day) and all average recurrence intervals (2-year through 1,000-year) for NOAA Atlas 14 Volume 2 are available on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html. These color maps were created to serve as visual aids only and should not be used for interpolating point or areal precipitation frequency estimates. Point and areal values should be obtained from the PFDS interface which gets data directly from the high resolution grids.

Final documentation to accompany the precipitation frequency estimates of NOAA Atlas 14 Volume 2 is currently being written. Most of the document is identical to NOAA Atlas 14 Volume 1. Modifications are being made where needed to reflect the different data set and area coverage and recent modifications to the procedures. Table 1 shows the progress of the documentation. Most of the sections that are "In progress" are at least 90% complete.

Table 1. Progress of NOAA Atlas 14 Volume 2 documentation.

Section description	**Status**
Title, Abstract & Preface	Complete
Introduction	Complete
Methods - data	In progress
Methods - analysis	In progress
Methods - spatial interpolation	In progress
PFDS	In progress
Peer Review	In progress
Interpretation	In progress
Appendix 1:Temporal Distributions	In progress
Appendix 2: Seasonality	Complete
Appendix 3: Trend	In progress
Appendix 4: PRISM report	Complete
Appendix 5: Peer Review	In progress
Appendix 6: Station lists	In progress
Appendix 7: Regional statistical tables	Complete
Appendix 8: Heterogeneity (H1) tables	Complete
Appendix 9: Regional growth factor tables	Complete
Glossary	Complete
References	Complete

3.2 Precipitation Frequency Data Server

The Precipitation Frequency Data Server (PFDS) - the on-line portal for all NOAA Atlas 14 deliverables and information - under went several subtle, but important changes. They include:

1. Added several frequently asked questions (FAQ) to the FAQ page.
2. Added this important cartographic map usage caveat to the "GIS Data and Maps" page:

   The color maps should not be used for interpolating point or areal precipitation frequency estimates. Point and areal values should be obtained from the PFDS interface which gets data directly from the high resolution grids. The color maps were created to serve as visual aids only.

3. Continued to update the PFDS Performance and Stats page on a monthly basis (see below).
4. Made several subtle changes to the NOAA Atlas 14 Download page, however plans are underway to make this page even more user-friendly in the future.
5. Reorganized state-specific pages
   a. Moved buttons to ancillary information to top of page
   b. Added NWS background to top of page
   c. Added FAQ button

On December 12, 2004 the server was replaced with a much faster computer which reduces waiting time when downloading results.

HDSC continuously monitors the hits, integrity and performance of the PFDS. The graph (Figure 3) below summarizes the number of individual data inquires made since January 2004, while the map (Figure 4) indicates the locations of inquires during the past quarter.

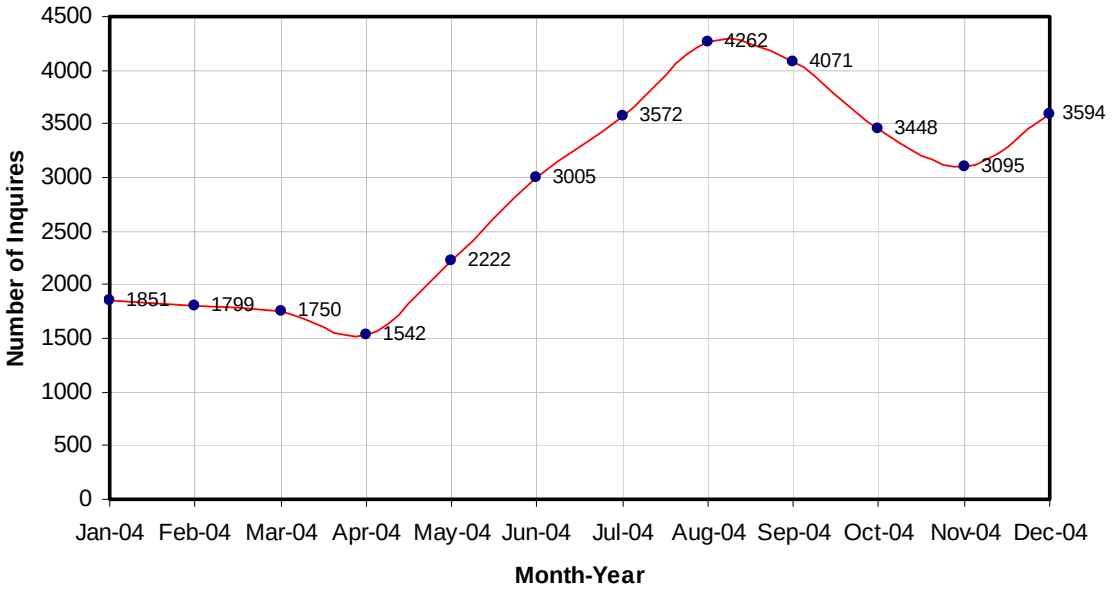


Figure 3. Number of individual PFDS data inquires per month.

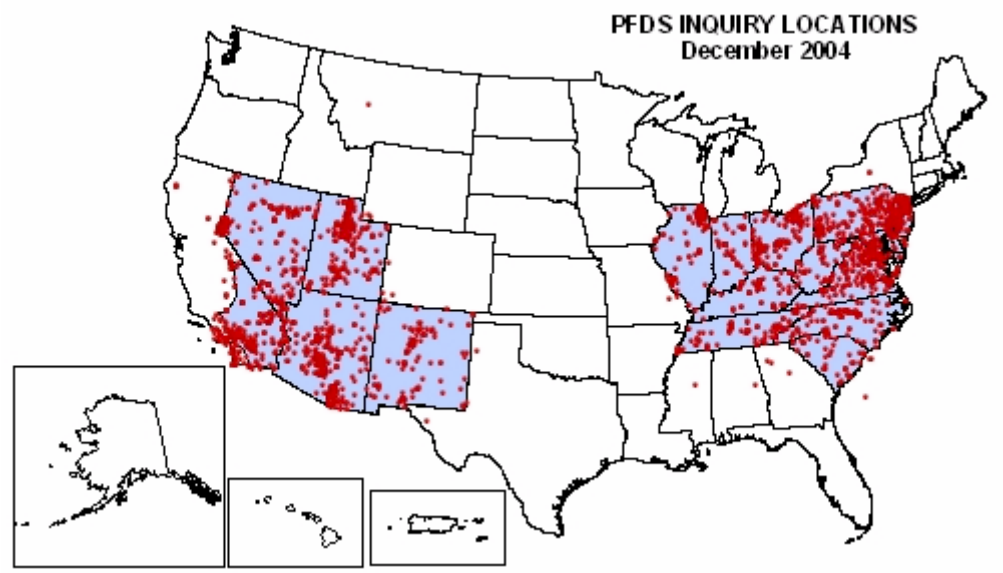


Figure 4: Map of 10,137 PFDS data inquiry locations during the period October-December 2004.

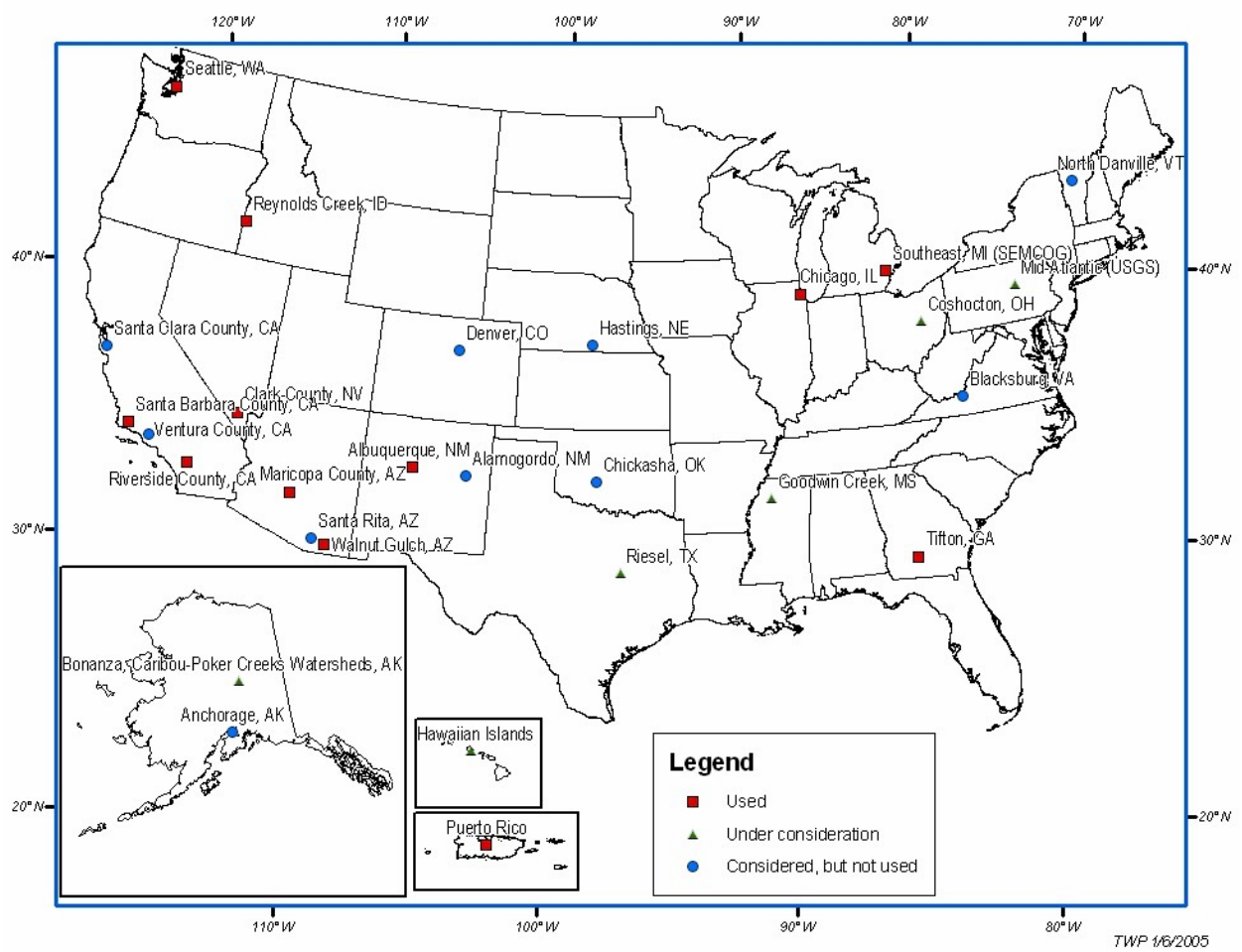
3.3 Areal Reduction Factors

Progress continues in the development of geographically-fixed Areal Reduction Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing

of software from the procedure described in NOAA Technical Report NWS 24 continues and is 95% completed.

Quality control of the recently added study area, Santa Barbara County, CA has been completed. The Chickasha, OK study area has been put on hold pending permission from the Oklohoma Mesonet for use of the data. The Ventura County, CA study area was eliminated due to unsuitable data records. Currently, there are 14 sites located throughout the conterminous US, Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis (see Figure 5). The "not used" study areas indicated in Figure 5 were considered but judged inadequate for the study due to lack of station density, poor data, limited or no metadata, or other problems.

Figure 5: Map of ARF study areas



4. Issues

4.1 International Cooperation

Members of HDSC were invited to the Nanjing Hydraulic Research Institute (NHRI) in Nanjing, China to demonstrate the techniques used on this project. Geoff Bonnin, Bingzhang Lin and Debbie Todd presented a seminar on December 9-10th, 2004. The seminar focused on the theory and practical application of regional precipitation frequency analysis using L-moments as used in HDSC. Members of various agencies of the Chinese Ministry of Water Resources (MWR) and various other agencies and Universities attended. These agencies included the NHRI Department of Hydrology and Water Resources, UNESCO-IHP Intergovernmental Council Bureau and Institute for Water Education, MWR Bureau of Hydrology and Office for National Flood Controlling and Commanding System, Reconnaissance, Planning, Design and Research Institute of Yellow River Conservancy Commission, Hohai University, and Tongji University. The scientific exchange was well received and generated interest in future collaboration.

The series of presentations included:

- *Recent Updates to U.S. Rainfall Frequency Estimates: Overview* by Geoff Bonnin
- *Seminar on Regional L-moments Analysis Method* by Bingzhang Lin
- *Implementation of Regional Precipitation Frequency Analysis using L-Moments* by Debbie Todd
- *Recent Updates to U.S. Rainfall Frequency Estimates: Spatial Analysis* by Geoff Bonnin
- *Recent Updates to U.S. Rainfall Frequency Estimates: Program Management* by Geoff Bonnin

5. Projected Schedule and Remaining Tasks

The following list provides a tentative schedule with completion dates. Brief descriptions of tasks being worked on next quarter are also included in this section.

Final Documentation [February 2005]
Spatial Relations (Areal Reduction Factors) [May 2005]

5.1 Final Documentation

Final documentation will be published during the next quarter.

5.2 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed for 14 areas. The resulting curves will be tested for differences to determine if a single set of ARF curves is applicable to the entire U.S. or whether curves vary by region.

References

Arkell, R.E., and F. Richards, 1986: Short duration rainfall relations for the western United States, Conference on Climate and Water Management-A Critical Era and Conference on the Human Consequences of 1985's Climate, August 4-7, 1986. Asheville, NC.

Bonnin, G., D. Todd, T. Parzybok, B. Lin, D. Riley, and M. Yekta, 2004: Precipitation frequency atlas of the United States. NOAA Atlas 14 Volume 1, Silver Spring, Maryland. http://hdsc.nws.noaa.gov/hdsc/.

Chow, V.T., D.R. Maidment, and L.W. Mays, 1988: Applied Hydrology. McGraw-Hill International Editions, 572 pp.

Frederick, R.H. and J.F. Miller, 1979: Short Duration Rainfall Frequency Relations for California, Third Conference on Hydrometeorology, August 20-24, 1979. Bogata Columbia.

Frederick, R.H., V.A. Myers and E.P. Auciello, 1977: Five- to 60-minute precipitation frequency for the eastern and central United States, NOAA Technical Memo. NWS HYDRO-35, Silver Spring, MD, 36 pp.

Hershfield, D.M., 1961: Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years, *Weather Bureau Technical Paper No. 40*, U.S. Weather Bureau. Washington, D.C., 115 pp.

Hosking, J.R.M. and J.R. Wallis, 1997: *Regional frequency analysis, an approach based on L-moments*, Cambridge University Press, 224 pp.

Huff, F. A., 1990: Time Distributions of Heavy Rainstorms in Illinois, *Illinois State Water Survey*, Champaign, 173, 17pp.

Institution of Engineers, Australia, 1987: *Australian Rainfall and Runoff, 3rd Edition*, The Institution of Engineers, Australia. Canberra.

Lin, B. and L.T. Julian, 2001: Trend and shift statistics on annual maximum precipitation in the Ohio River Basin over the last century. Symposium on Precipitation Extremes: Prediction, Impacts, and Responses, 81st AMS annual meeting. Albuquerque, New Mexico.

Miller, J.F., 1964: Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States, *Technical Paper No. 49*, U.S. Weather Bureau and U.S. Department of Agriculture, 29 pp.

Miller, J.F., R.H. Frederick and R.J. Tracy, 1973: Precipitation-frequency atlas of the western United States, *NOAA Atlas 2*, 11 vols., National Weather Service, Silver Spring, MD.

Myers, V.A. and R.M. Zehr, 1980: A Methodology for Point-to-Area Rainfall Frequency Ratios, NOAA Technical Report NWS 24, Office of Hydrology, National Weather Service, Silver Spring, MD.